semiconductor layer 3A composed of $Al_{x2}Ga_{1-x2}N$ provided on the second nitride semiconductor layer.

The Examiner considers that the thickness of the first nitride semiconductor layer (A1N) and the Al composition ratio xl in the second nitride semiconductor layer are art-recognized result-oriented parameters subject to routine experimentation and optimization. Regarding this last point, the Examiner contends that the AIN layer is known in the art as a buffer layer which can commonly have a thickness within the claimed range (citing U.S. 6,475,923 to Mitamura), and that Shibata expressly discloses that the lower Al composition ratio in the second nitride semiconductor layer as compared with that in the first nitride semiconductor layer can desirably reduce dislocation density (citing paragraph [0047] and [0048]).

As to the claimed third nitride semiconductor layer, the Examiner notes that the corresponding working examples in Shibata (where x=0.95) is within the scope of the original claims, and that the Al composition ratio of the third nitride semiconductor layer which functions as a top buffer layer is also an art-recognized result-oriented parameter subject to routine experimentation and optimization. Regarding this last point, the Examiner cites top buffer layer 3, 103 in Chang.

The rejection should be withdrawn because (i) Shibata does not disclose an upper limit for the Al content of 0.05 as claimed in claim 1; (ii) the Examiner has given no reason why one of ordinary skill would have reduced the Al content of the second nitride to an amount of one-half or less than that instructed by Shibata with any reasonable expectation of reducing dislocation density; and (iii) contrary to the Examiner's suggestion, Chang does not disclose the Al composition ratio of the third nitride semiconductor layer of the present invention. This is

discussed in further detail below.

Pursuant to MPEP § 2144.05, a particular parameter must first be recognized as a result-effective variable before the determination of the optimum or workable ranges of that variable might be characterized as routine experimentation.

Shibata paragraph [0045] teaches that the Al content of the second nitride (2-1, 2-2, 2-3 and 2-4) is larger than the Al content of the first nitride (AlN single crystal 1). As described in paragraph [0047], the Al content of the second nitride (2-1, 2-2, 2-3 and 2-4) is preferably greater than or equal to 0.1 higher and more preferably 0.5 higher than the Al content of the first nitride (AlN single crystal 1). In the working examples, the Al content of the second nitride (corresponding to the claimed first nitride) is x1=0.1 which is the lower limit given in paragraph [0047] and twice the upper limit of 0.05 as set forth in present claim 1.

Although Shibata discloses that the Al content of the second nitride is set larger than the Al nitride to reduce dislocation density, in no way does this discloses an upper limit for the Al content 0.05 as claimed in claim 1.

Meanwhile, *KSR* holds that it is necessary to identify a reason that would prompt a person of ordinary skill in the art would fail to make the asserted modification. Further, *a prima facie* case of obviousness cannot be maintained if one of ordinary skill in the art would not have possessed at least a reasonable expectation of success in making such a modification.

Here, the Examiner has given no reason why one of ordinary skill would have reduced the Al content of the second nitride (2-1, 2-2, 2-3 and 2-4) to an amount of one-half or less than that instructed by Shibata with any reasonable expectation of reducing dislocation density.

As claimed in claim 1, the third nitride semiconductor layer has a Al content $x2 < 0.5$. The Examiner asserts that the Al content of this layer is recognized as a result-effective variable subject to routine optimization.

However, the claimed upper limit of ≤ 0.5 is substantially less than the Al content of 0.95 as employed in the working examples of Shibata. The Examiner points to no guidance in Shibata for setting the Al content of the epitaxial grown nitride film 3A, but relies on Chang as showing that it would have been obvious to set the Al content x2 within the claimed range because Chang teaches that such Al content for an analogous top buffer layer (dislocation inhibition layer) is within the claimed range.

Chang describes that the dislocation inhibition layer 203 is preferably made of $Al_xIn_yGa_{1-x-Y}N$, wherein $0\leq x\leq 1$, $0\leq y\leq 1$, and $0\leq x+y\leq 1$, and more preferably, made of GaN-based material such as GaN, A1N and AlGaN (see column 3, lines 11 to 14, of Chang). Namely, Chang discloses that every Group III nitride semiconductor may be grown on the multiple nucleuses 2 as the dislocation inhibition layer, and does not disclose that the Al composition ratio of the dislocation inhibition layer is preferably 0.5 or less.

On the other hand, in the exemplary embodiment, by adjusting Al composition ratio of each layer to the claimed range, respectively, the initial growth of A1GaN crystals constituting the third nitride semiconductor layer is dominated by the GaN growth mode, whereby the dislocation density of the resultant crystals is reduced, and the crystallinity thereof is improved. Namely, in the exemplary embodiment, the combination of each Al composition ratio of the first, second and third nitride semiconductor layers is maintained, and the Al composition ratio of the third nitride semiconductor layer is 0.5 or less and is larger than that of the second nitride semiconductor layer by at least 0.02.

Therefore, the Examiner's indication that the Al composition ratio of the third nitride semiconductor layer of the present invention is disclosed in Chang is not reasonable.

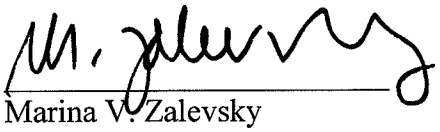
In view of the foregoing remarks, it is respectfully submitted that the present claims are patentable over Shibata and Chang, and withdrawal of the foregoing rejection is respectfully requested.

Withdrawal of all rejections and allowance of claims 1-4, 6-14, and 16 are earnestly solicited.

In the event that the Examiner believes that it may be helpful to advance the prosecution of this application, the Examiner is invited to contact the undersigned at the local Washington, D.C. telephone number indicated below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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